

Framework for Understanding the Adoption of AI Technologies in Agriculture



Policy Brief

March 2025



Ontario



UNIVERSITY OF GUELPH

Introduction

AI-powered technologies, such as soil health monitoring devices, milk yield prediction, robotics, automated irrigation, and livestock monitoring and disease detection, use artificial intelligence to mimic human intelligence for decision-making and problem-solving. The integration of Artificial Intelligence (AI) technologies in agriculture, particularly in Ontario's horticultural crops and livestock sectors, presents significant potential for boosting efficiency, productivity, and environmental sustainability. Despite the potential, the adoption of digital technologies is uneven due to factors including high costs, regulatory gaps, skill shortages, an aging farming population, and limited access to information.

This brief presents a framework for understanding the key factors that influence the adoption of AI technologies. It utilizes a multiple-level approach that includes individual, social, environmental, institutional, and technological factors to highlight different interactions of variables that can either facilitate or hinder AI adoption.

Policy options supporting strategic interventions for AI adoption are outlined, recognizing interdependencies in the adoption process and promoting responsible AI integration. These recommendations aim to inform the development of inclusive, evidence-based AI adoption strategies that are aligned with industry needs

Context: Technology Adoption in Ontario

In Ontario, over 50% of farms use digital tools such as soil sampling, automation, AI, and data analytics (Hall et al., 2024). The province accounts for over 25% of Canada's farms and 61% of its greenhouse space, leading in poultry, vegetable, and greenhouse production. Furthermore, there are more than 3,000 dairy farmers in Ontario (Rana et al., 2024). While AI adoption can improve decision-making, productivity, and resource use, ignoring societal concerns and responsible innovation may lead to low adoption rates, job displacement, inequality, and ethical challenges. Key barriers to technology adoption in Ontario agriculture include a disconnect between policy intentions and practical outcomes, which limits access to funding (Greene & Murphy, 2021). Public and private investment, particularly in Controlled Environment Agriculture (CEA), can also be improved (Fonseka et al., 2024). Additionally, insufficient training hinders producers' ability to fully utilize new technologies, while the aging producer population raises concerns about succession planning (Rana et al., 2024).

Framework on Key Factors Influencing AI Adoption

The following framework aligns with three critical perspectives: systemic views on capacity development, responsible innovation, and an analysis of the content layer characteristics of AI technology. It then categorizes the factors influencing AI adoption into individual, social, environmental, technological, and institutional levels.

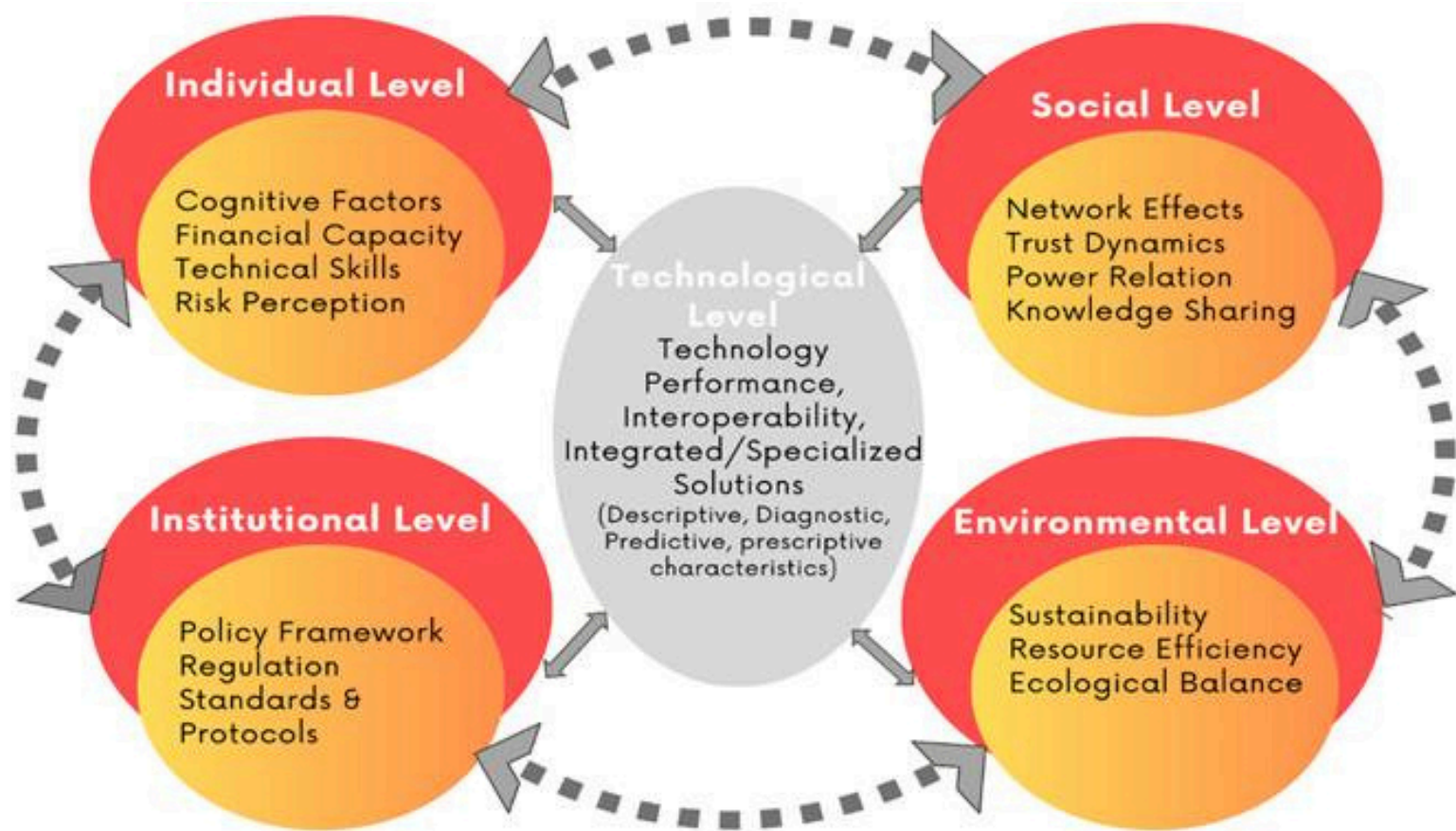


Figure 1. Key factors that influence the adoption of AI technologies

Farmers' knowledge, attitudes, and risk perceptions, along with financial barriers like high costs and lack of incentives, shape their adoption decisions (Green et al., 2021; Makinde et al., 2022). Risk perception, particularly concerns about technological failure, also affects their willingness to invest in AI (Fonseka et al., 2024; Leeuwis & Aarts, 2021). Socially, peer influence, knowledge sharing, and community support help farmers make informed choices, while trust in technology and its developers is essential (Chowdhury et al., 2025). Institutional factors such as rural broadband access, government policies, and regulations play a critical role, with limited broadband and unclear regulations hindering adoption (Hall et al., 2024; Rana et al., 2024). Technologically, the distinct features of AI technology influence its capacity to inform decision-making and drive adoption. (Njuguna et al., 2025). Sustainability concerns, including the ecological impact and energy use of AI technologies, present environmental challenges to adoption (Raghav et al., 2024).

What Should Policymakers Do?

Policy Option 1: Strategic Interventions for Effective AI Adoption

Categorizing different adoption barriers enables policymakers to design strategies that address the specific needs of individual farmers. Enabling more effective interventions and better allocation of resources, such as training programs and funding, that maximize the benefits of AI adoption. This aligns with existing concerns about the need for more public-private partnerships (Fonseka et al., 2024).

Policy Option 2: Interdependencies in AI Adoption

The adoption of AI technology is often influenced by multiple factors; social norms, institutional policies, and environmental elements play huge roles in this process. Furthermore, the specific features and characteristics of AI technologies can also shape adoption decisions. For instance, the adoption of AI-driven decision support systems, such as AI-assisted milk yield prediction, may be influenced by the availability of reliable data, access to technology, as well as the financial implications of the investment. Policymakers should consider these factors when designing interventions, as a holistic approach is best suited to promote AI adoption.

Policy Option 3: Responsible AI Integration

Facilitating the adoption of responsible AI maximizes the potential benefits. Policymakers should prioritize strategies that promote inclusive dialogue, skill development, and support for farmers to ensure that AI technologies are effectively integrated into agricultural practices.

Way Forward

Understanding the framework for AI adoption in Ontario's horticultural crop and livestock sectors aligns with the broader studies on digital technology adoption. By designing strategies for inclusive AI adoption and leveraging opportunities for responsible innovation and collaboration among stakeholders, Ontario can continue to drive the successful adoption of AI technologies in Canadian agriculture.

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This brief was developed under the project funded by the Ontario Agri-Food Innovation Alliance titled “Enabling Responsible AI-Driven Agri-Food Innovation in Ontario: Challenges and Opportunities”.